

# Sintesis $\text{LiNi}_{0,8}\text{Mn}_{0,1}\text{Co}_{0,1}\text{-xMo}_x\text{O}_2/\text{C}$ menggunakan kombinasi Metode Solution-Combustion dan Solid State dan karakterisasinya untuk katode baterai Ion Litium = Synthesis of $\text{LiNi}_{0,8}\text{Mn}_{0,1}\text{Co}_{0,1}\text{-xMo}_x\text{O}_2/\text{C}$ using a combination of Solution-Combustion and Solid-State Methods and their characterization for Lithium-Ion battery cathode

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## Abstrak

Sintesis menggunakan kombinasi metode solution combustion synthesis (SCS) dan solid state telah dilakukan dan diuji coba untuk mendapatkan katode baterai ion litium  $\text{LiNi}_{0,8}\text{Mn}_{0,1}\text{Co}_{0,1}\text{-xMo}_x\text{O}_2/\text{C}$  dengan prekursor  $\text{LiNO}_3$ ,  $\text{Ni}(\text{NO})_3 \cdot 6\text{H}_2\text{O}$ ,  $\text{Mn}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ ,  $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ ,  $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}$ , dan  $\text{CH}_4\text{N}_2\text{O}$  sebagai bahan bakar dengan dilarutkan dengan aquades dan diaduk menggunakan hot plate magnetic stirrer pada temperatur ruangan. Larutan dipanaskan pada temperature  $100^\circ\text{C}$  selama 1 jam hingga  $200^\circ\text{C}$  selama 2 jam hingga terbentuk pasta cokelat. Pemanasan lanjutan dilakukan pada muffle furnace pada temperature  $500^\circ\text{C}$  selama 2 jam, dan kalsinasi pada temperature  $900^\circ\text{C}$  selama 3 jam. Super-p carbon black ditambahkan sebagai adisi sebanyak 0,5 wt% dan dicampurkan dengan serbuk NMC 811 menggunakan agathe mortar selama 1 jam dan kalsinasi pada  $300^\circ\text{C}$  selama 3 jam. Serbuk berwarna hitam hasil sintesis dianalisis mikroskop elektron (SEM) untuk melihat morfologi, Hasil SEM menunjukkan sampel hasil sintesis memiliki ukuran dengan kisaran 0,1-1,55  $\mu\text{m}$ . uJI difraksi sinar-X (XRD) untuk melihat kristalinitas dan menunjukkan bahwa terjadi pergeseran puncak 2 ke arah kanan karena pengaruh oksida logam yang terbentuk. Analisis elektrokimia dilakukan dengan impedansi elektrokimia (EIS) untuk melihat hambatan yang dihasilkan dan berpengaruh terhadap konduktivitas listrik dari katode. Hasil karakterisasi memperlihatkan bahwa penambahan Mo dengan jumlah tertentu dan karbon yang merata dapat meningkatkan konduktivitas listrik dari katode NMC 811. Uji Cyclic Voltametry (CV) menunjukkan puncak oksidasi reduksi yang lebih dari 1 dan mengindikasikan pengotor.

.....Synthesis using a combination of solution combustion synthesis (SCS) and solid state methods has been carried out and tested to obtain a lithium ion battery cathode  $\text{LiNi}_{0,8}\text{Mn}_{0,1}\text{Co}_{0,1}\text{-xMo}_x\text{O}_2/\text{C}$  with precursors  $\text{LiNO}_3$ ,  $\text{Ni}(\text{NO})_3 \cdot 6\text{H}_2\text{O}$ ,  $\text{Mn}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ ,  $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ ,  $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}$ , and  $\text{CH}_4\text{N}_2\text{O}$  as fuel by being dissolved in distilled water and stirred using a hot plate magnetic stirrer at room temperature. The solution was heated at a temperature of  $100^\circ\text{C}$  for 1 hour to  $200^\circ\text{C}$  for 2 hours to form a dark brown paste. Further heating was carried out in a muffle furnace at a temperature of  $500^\circ\text{C}$  for 2 hours, and calcination at a temperature of  $900^\circ\text{C}$  for 3 hours. Super-p carbon black was added as addition as much as 0.5 wt% and mixed with NMC 811 powder using agathe mortar for 1 hour and calcined at  $300^\circ\text{C}$  for 3 hours. The synthesized black powder was analyzed by electron microscopy (SEM) to see morphology. SEM results showed that the synthesized sample had a size in the range of 0.1-1.55 m. X-ray diffraction test (XRD) to see the crystallinity and showed that there was a shift of the 2 peak to the right due to the influence of the metal oxide formed. Electrochemical analysis was carried out with electrochemical impedance (EIS) to see the resulting resistance and its effect on the electrical conductivity of the cathode. The characterization results showed that the addition of a certain amount of Mo and an even distribution of

carbon could increase the electrical conductivity of the NMC 811 cathode. Cyclic Voltammetry (CV) test showed an oxidation-reduction peak that was more than 1 and indicated an impurity.